

What is claimed is:

1. A cooling apparatus boiling and condensing refrigerant, having a refrigerant tank portion having a heat generating element mounted on a surface thereof and adapted to store therein a refrigerant and a heat exchanging portion for executing heat exchange between said refrigerant that boils by receiving heat generated from said heat generating element and a cooling medium and constructed, as a whole, by stacking a number of plate-like members, wherein

first openings that form part of refrigerant passages and second openings that form part of cooling passages are provided in said plurality of plate-like members which are used for said heat exchanging portion, said first opening portions being adapted to establish a communication with an internal space of said refrigerant tank portion.

2. A cooling apparatus boiling and condensing refrigerant as set forth in claim 1, wherein two different types of plate-like members, which are different from each other in at least the location of said second openings, are used for said plate-like members used for said heat exchanging portion, said two types of plate-like members being stacked alternately so that said second openings thereof partly communicate with each other.

3. A cooling apparatus boiling and condensing refrigerant as set forth in claim 2, wherein said two types of plate-like members each have pillar portions which divide said respective second openings, the locations of said pillar portions being different from each other between said two types of plate-like members.

4. A cooling apparatus boiling and condensing refrigerant as set forth in claim 1, wherein inner fins are inserted in said refrigerant passages and said cooling passages or either of them for increasing the heat conducting surface area.

5. A cooling apparatus boiling and condensing refrigerant as set forth in claim 4, wherein said inner fins are each formed into a configuration having elasticity.

5 6. A cooling apparatus boiling and condensing refrigerant as set forth in Claim 1, wherein said cooling medium is liquid such as water.

10 7. A cooling apparatus boiling and condensing refrigerant, having a refrigerant tank portion having a heat generating element mounted on a surface thereof and adapted to store therein a refrigerant, a refrigerant diffusing portion for diffusing said refrigerant that boils by receiving heat from said heat generating element and a heat exchanging portion provided between said 15 refrigerant tank portion and said refrigerant diffusing portion for executing heat exchange between said boiling refrigerant and a cooling medium and constructed, as a whole, by stacking a number of plate-like members, wherein

20 first openings that form part of refrigerant passages and second openings that form part of cooling passages are provided in those of said plurality of plate-like members which are used for said heat exchanging portion, said first opening portions being adapted to establish communications with internal 25 spaces of said refrigerant tank portion and said refrigerant diffusing portion.

30 8. A cooling apparatus boiling and condensing refrigerant as set forth in claim 7, wherein two different types of plate-like members, which are different from each other in at least the location of said second openings, are used for said plate-like members used for said heat exchanging portion, said two types of plate-like members being stacked alternately so 35 that said second openings thereof partly communicate with each other.

9. A cooling apparatus boiling and condensing

refrigerant as set forth in Claim 8, wherein said two types of plate-like members each have pillar portions which divide said respective second openings, the locations of said pillar portions being different from each other between said two types of plate-like members.

5 10. A cooling apparatus boiling and condensing refrigerant as set forth in claim 7, wherein inner fins are inserted in said refrigerant passages and said cooling passages or either of them for increasing the heat conducting surface area.

10 11. A cooling apparatus boiling and condensing refrigerant as set forth in Claim 10, wherein said inner fins are each formed into a configuration having an elasticity.

15 12. A cooling apparatus boiling and condensing refrigerant as set forth in claim 7, wherein the internal capacity of said refrigerant tank portion is set larger than a sum of an internal capacity formed by said first openings of the entirety of said heat exchanging portion and the internal capacity of said refrigerant diffusing portion.

20 25 13. A cooling apparatus boiling and condensing refrigerant as set forth in claim 7, wherein said first openings provided in said heat exchanging portion are each constituted by a group of opening holes in which a plurality of opening holes that are each opened in a circular or rectangular configuration are formed in a continuous fashion.

30 35 14. A cooling apparatus boiling and condensing refrigerant as set forth in claim 7, wherein tank portions are provided on said plate-like members used for said heat exchanging portion at ends of said second openings, and wherein heat exchanging areas are provided on said plate-like members constituting said refrigerant tank portion and said refrigerant diffusing portion for executing a heat exchange between said cooling medium that flows through said tank portions and said

refrigerant.

15. A cooling apparatus boiling and condensing refrigerant as set forth in claim 7, wherein said heat generating element is mounted at a substantially central portion of the surface of said refrigerant tank portion, and wherein the internal capacity of a portion of said refrigerant tank portion which belongs to an area of said refrigerant tank portion which is excluded from an area thereof where said heat generating element is mounted is set larger than the internal capacity of a portion of said refrigerant tank portion which belongs to the area thereof where said heat generating element is mounted.

10 15 16. A cooling apparatus boiling and condensing refrigerant as set forth in claim 7, wherein said cooling medium is a liquid such as water.

17. A cooling apparatus boiling and condensing refrigerant, having a refrigerant tank portion having a heat generating element mounted on a surface thereof and adapted to store therein a refrigerant and a heat 20 exchanging portion for executing heat exchange between said refrigerant that boils by receiving heat from said heat generating element and a cooling medium and constructed, as a whole, by stacking a number of plate-like members, wherein

25 said heat exchanging portion is constructed by alternately stacking said first plate-like members having first openings that form part of refrigerant passages to communicate with an internal space in said refrigerant tank portion and second openings that form part of cooling passages and said 30 second plate-like members having at least said first openings, said second plate-like member being set to be thinner than said first plate-like member so as to have a function as a fin.

35 18. A cooling apparatus boiling and condensing refrigerant as set forth in claim 17, wherein said second plate-like member has a communication port which

communicates with said second opening formed in said first plate-like member.

19. A cooling apparatus boiling and condensing refrigerant as set forth in claim 18, wherein said second opening in said first plate-like member is provided in such a manner as to be divided into a second opening portion and another second opening portion with a pillar portion being left therebetween, and wherein

10 said communication port formed in said second plate-like member is adapted to communicate with both said second opening portion and said other second opening portion.

15 20. A cooling apparatus boiling and condensing refrigerant as set forth in claim 17, wherein a sacrificial material is affixed to one or both sides of at least either of said first plate-like member and said second plate-like member which are both made of a metal.

20 21. A cooling apparatus boiling and condensing refrigerant as set forth in claim 17, wherein said second-plate like member has a plurality of cut and erected pieces which are provided in such a manner as to be cut and erected from the surface thereof, and wherein said cut and erected pieces protrude into said second opening formed in said first plate-like member.

25 22. A cooling apparatus boiling and condensing refrigerant as set forth in claim 17, wherein said second plate-like member is provided such that the surface of said second plate-like member becomes irregular within said second opening formed in said first plate-like member.

30 35 23. A cooling apparatus boiling and condensing refrigerant as set forth in claim 17, wherein said first openings formed in said plurality of plate-like members that are used for said heat exchanging portion are adapted to communicate with one another to form refrigerant passages that communicate with said refrigerant tank portion, and wherein barrier wall

portions are provided in said refrigerant passages for disturbing the flow of said refrigerant.

24. A cooling apparatus boiling and condensing refrigerant as set forth in claim 17, wherein said cooling medium is a liquid such as water.

5 25. A cooling apparatus boiling and condensing refrigerant, having a refrigerant tank portion having a heat generating element mounted on a surface thereof and adapted to store therein a refrigerant, a refrigerant diffusing portion for diffusing said refrigerant that boils by receiving heat from said heat generating element and a heat exchanging portion provided between said refrigerant tank portion and said refrigerant diffusing portion for executing a heat exchange between said 10 boiling refrigerant and a cooling medium and constructed, 15 as a whole, by stacking a number of plate-like members, wherein

20 said heat exchanging portion is constructed by alternately stacking said first plate-like members having first openings that form part of refrigerant passages to communicate with internal spaces in said refrigerant tank portion and said refrigerant diffusing portion, and second openings that form part of cooling passages and said second plate-like members 25 having at least said first openings, said second plate-like member being set to be thinner than said first plate-like member so as to have a function as a fin.

30 26. A cooling apparatus boiling and condensing refrigerant as set forth in claim 25, wherein said second plate-like member has a communication port which communicates with said second opening formed in said first plate-like member.

35 27. A cooling apparatus boiling and condensing refrigerant as set forth in claim 26, wherein said second opening in said first plate-like member is provided in such a manner as to be divided into a second opening portion and another second opening portion with a pillar

portion being left therebetween, and wherein
said communication port formed in said
second plate-like member is adapted to communicate with
both said second opening portion and said other second
5 opening portion.

28. A cooling apparatus boiling and condensing
refrigerant as set forth in claim 25, wherein a
sacrificial material is affixed to one or both sides of
at least either of said first plate-like member and said
10 second plate-like member which are both made of a metal.

29. A cooling apparatus boiling and condensing
refrigerant as set forth in claim 25, wherein said
second-plate like member has a plurality of cut and
erected pieces which are provided in such a manner as to
15 be cut and erected from the surface thereof, and wherein
said cut and erected pieces protrude into said second
opening formed in said first plate-like member.

30. A cooling apparatus boiling and condensing
refrigerant as set forth in claim 25, wherein said second
20 plate-like member is provided such that the surface of
said second plate-like member becomes irregular within
said second opening formed in said first plate-like
member.

31. A cooling apparatus boiling and condensing
refrigerant as set forth in claim 25, wherein said first
25 openings formed in said plurality of plate-like members
that are used for said heat exchanging portion are
adapted to communicate with one another to form
refrigerant passages that communicate with said
refrigerant tank portion, and wherein barrier wall
30 portions are provided in said refrigerant passages for
disturbing the flow of said refrigerant.

32. A cooling apparatus boiling and condensing
refrigerant as set forth in claim 25, wherein said
35 cooling medium is a liquid such as water.